LIST OF U.S. CUSTOMS LABORATORY METHODS

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85-01	USCL Manual	Determining the Output of Electric Motors

U.S. CUSTOMS LABORATORY METHODS

USCL METHOD 85-01 INDEX

Determining The Output of Electric Motors

SAFETY PRECAUTIONS

This method does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to its use.

0 INTRODUCTION

To properly classify an electric motor in HTSUS Chapter 85 it is necessary to determine the output rating of the motor in watts (W). Classification falls under one of several HTSUS numbers depending on the type of the motor (synchronous, a.c., d.c., universal a.c./d.c.) and the output rating of the motor in one of the following categories.

0.1 Of under 18.65 W

0.2 Of 18.65 W or more but not exceeding 37.5 W

0.3 Exceeding 37.5 W but not exceeding 74.6 W

0.4 Exceeding 74.6 W but not exceeding 735 W

0.5 Exceeding 735 W but under 746 W

0.6 Of 746 W or more but not exceeding 750 W

0.7 Exceeding 750 W but not exceeding 14.92 kW

0.8 Exceeding 14.92 kW but not exceeding 75 kW

0.9 Exceeding 75 kW but under 149.2 kW

0.10 Of 149.2 kW or more but not exceeding 150 kW

0.11 Exceeding 150 kW but not exceeding 373 kW

0.12 Exceeding 373 kW but not exceeding 375 kW

0.13 Of an output exceeding 375 kW

1 SCOPE

In the United States electric motors, like any other motors, are usually rated in horsepower (hp). Fractions of a horsepower are most often used to designate the rating of small electric motors, however millihorsepower (mhp) is sometimes used for rating subfractional horsepower motors, and subfractional horsepower motors may be rated in watts. Additional U.S. Note 1 to Chapter 85 states "For the purpose of headings 8501 and 8503, 746 watts (W) is taken to be equivalent to 1 horsepower (hp)." Some countries express power output in chevaux-vapeur (cv); 1 cv is equivalent to 735.5 W. Most of the tariff breakouts listed above are multiples of a horsepower, expressed in watts; a chevaux-vapeur, expressed in watts; or 750 watts.

The National Electrical Manufacturers Association (NEMA) publishes standards for output ratings of motors down to 1/20 horsepower. These standards should be followed, when applicable, in determining the output rating of motors of 37.3 W or greater.

As defined in Customs Internal Advices numbered 127-76 and 190-76 and affirmed in U.S. Court of International Trade Slip Op. 87-99, for subfractional horsepower electric motors of less than 1/20 horsepower (37.3 watts), the output rating is the maximum output the motor will produce for a period of 5 minutes during which the temperature of the motor does not increase to a value which causes permanent injury to the motor.

For d.c. motors of less than 37.3 W, the problem of determining the output rating of a particular motor is complicated by the common practice of using these types of motors at several different voltages and loads; the exact voltage and load used being determined by the characteristics of the motor and the particular application to be made of it by the end user. Therefore, for d.c. motors the voltage and load which produces the maximum output (as measured by a dynamometer) the motor will produce for a period of five minutes without causing thermal runaway will be used to determine the output rating of the particular motor in question.

For a.c. motors the problem of determining the output rating of a particular motor is somewhat simpler because it is not a common practice to use this type of motor at different voltages. Generally, the voltage at which an a.c. motor has been designed to operate is stamped on the motor. Therefore, for the determination of the output rating of a particular motor under 37.3 watts only the load exerted on the motor shaft will be varied in order to determine the maximum output (using a dynamometer) the motor will produce for a period of 5 minutes during which the temperature of the motor does not increase to a value which causes permanent injury to the motor.

2 REFERENCES

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3 APPARATUS

3.1 Hysteresis Brake Dynamometer
(Magtrol Model HD-400-6 or equivalent)

3.2 Hysteresis Brake Power Supply
(Magtrol Model 4637 or equivalent).

3.3 Torque and Speed Indicators (Magtrol Model 4605 C or equivalent).

3.4 Motor Couplings (Variable sizes available from Lord Mfg. Co. Erie, Pa., or equivalent.)

3.5 **Motor Mounting Apparatus** (It is recommended that the motor be secured to the dynamometer base plate via an appropriate device because any torque applied to the motor shaft is equally present on the motor frame. Figure 1 illustrates such an acceptable device.)

3.6 **D.C. Power Supply -** Capable of producing 40 volts d.c. and a minimum of 30 amperes. (Hewlett Packard model 6268 B or equivalent.)

4 PROCEDURE

4.1 SCREENING TEST

4.1.1 Securely mount the motor with a suitable device so that the axis of the motor shaft is on a line with that of the dynamometer shaft. Alignment is critical, since either radial or angular misalignment may cause coupling losses. The mounting system must not thermally insulate the motor or interfere with designed ventilation. Also, it must not produce magnetic or electric distortions, and, insofar as possible, should not act as a heat sink.

4.1.2 Couple the motor to the dynamometer with a "soft" coupling. Type J-1211 couplings of various shaft diameters, available from Lord Manufacturing Co., are satisfactory. Do not couple the motor to the dynamometer with a metal sleeve or other rigid coupling. If the motor is properly aligned the torque readout should read "0" when the motor shaft is rotated slowly.

4.1.3 Apply the specified voltage; if no voltage is specified by the manufacturer, apply a low d.c. voltage (e.g., 2 or 4 v.d.c.) or, for a.c. motors, the 110-volt line voltage.

4.1.4 Apply torque (Q) in integral ounce-inches. If the output of the motor is slightly under 18.65 W at a certain voltage and an integral ounce-inch value of torque, and if the output decreases or remains nearly constant when an additional ounce-inch of torque is applied, then it will be necessary to apply torque in increments of 0.1 ounce-inch to determine if there is an intermediate torque which will provide 18.65 W at that voltage. The output of the motor can be calculated in watts using the following formula:

$$W = \frac{746 \times Q \times N}{5252}$$

Where Q = torque in lb. ft.
N = speed in RPM

Since the dynamometer used to measure the output of these small motors reads out in ounce inches rather than pound feet the formula becomes:

$$W = \frac{746 \times Q \times N}{5252 \times 192}$$

Where Q = torque in oz. in.
N = speed in RPM

(A short table indicating the speed required to produce 18.65 W at various values of torque will be found on Page 6).

4.1.5 If the motor exceeds 18.65 W output, then cool it to ambient temperature and proceed with the 5-minute test under the conditions established.

4.1.6 If motor stalls before reaching 18.65 W output, then reduce the torque, cool the motor to ambient temperature, increase the voltage (in integral volts), and resume screeningas under 4 above. Fractional voltage adjustments may be necessary as the output approaches 18.65 W.

4.8 If the motor insulation starts to burn or if the motor is otherwise damaged as a result of the test, then report as not over

18.65 W. This procedure often results in the destruction of the motor, since small motors must be "pushed" to ever-higher outputs until they either attain 18.65 W or are destroyed in the attempt. Therefore, appropriate safety precautions should be observed to protect the operator of the dynamometer.

The procedural sequence is set forth schematically on the attached flow-sheet (Figure 2).

5 FIVE-MINUTE TEST

5.1 Apply the voltage which produced an output greater than 18.65 W, as determined by the screening procedure.

5.2 Apply torque such that

$$\frac{746 \times Q \times N}{5252 \times 192} > 18.65 \text{ W, as}$$

determined by the screening procedure.

5.3 Record the speed at time zero, begin the five-minute test period, and record the rpm at one-minute intervals thereafter for five minutes.

5.4 If the speed: drops such that

$$\frac{746 \times Q \times N}{5252 \times 192} < 18.65 \text{ W,}$$

terminate the test and:

5.4.1 if the motor still works, re-screen, or

5.4.2 if motor is permanently damaged, report as less than 18.65 W.

5.5 is maintained such that

$$\frac{746 \times Q \times N}{5252 \times 192} > 18.65 \text{ W,}$$

and the motor is:

5.5.1 permanently damaged, report as less than 18.65 W

5.5.2 not permanently damaged, report as over 18.65 W.

SPEED AND TORQUE REQUIRED TO PRODUCE 18.65 W

If the torque is:		The speed for 18.65 W output must be:
1.0 OZ. IN.	--------------------------	25,210 RPM
1.5	------------------------------------	16,808
2.0	------------------------------------	12,606
2.5	------------------------------------	10,084
3.0	------------------------------------	8,403
3.5	------------------------------------	7,203
4.0	------------------------------------	6,302
4.5	------------------------------------	5,602
5.0	------------------------------------	5,042
6.0	------------------------------------	4,202
7.0	------------------------------------	3,601
8.0	------------------------------------	3,152
9.0	------------------------------------	2,801
10.0	------------------------------------	2,521
12.5	------------------------------------	2,017
15.0	------------------------------------	1,681
17.5	------------------------------------	1,441
20.0	------------------------------------	1,260
25.0	-------------------------------------	1,008

Figure 1. - Motor Mounting Apparatus:

Figure 2. -Screening Flowchart:

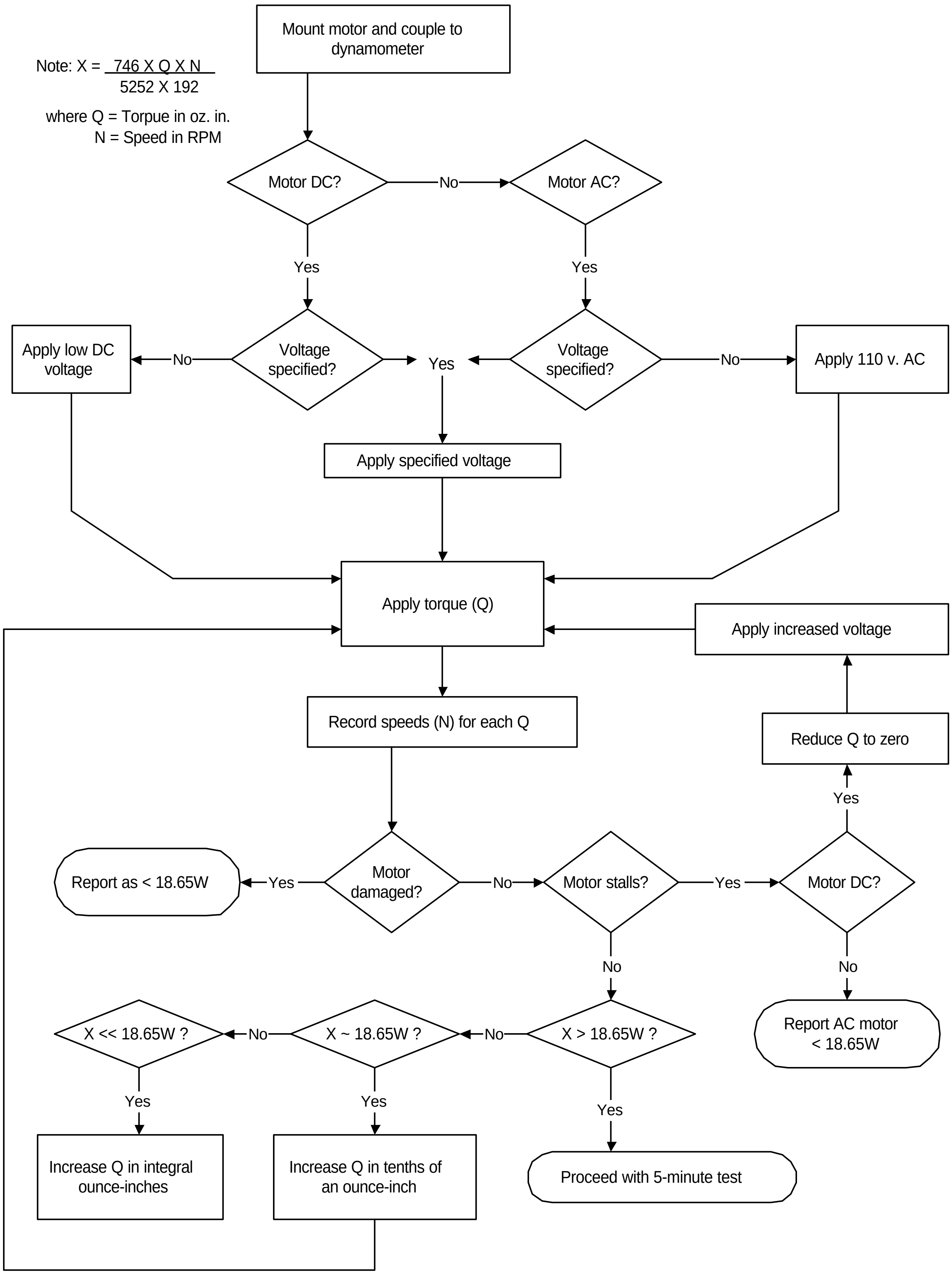

Figure 3: - 5-Minute Test Flowchart: